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ABSTRACT

The manual provides information and diagrams for constructing CAP, Communication Aid for Paraplegics and other severely physically handicapped persons. Also described are factors influencing the design and modification of the alphabet display. It is explained that CAP combines a teletypewriter with a rotating alphabet display and requires only a single muscle movement to select letters. (CL)

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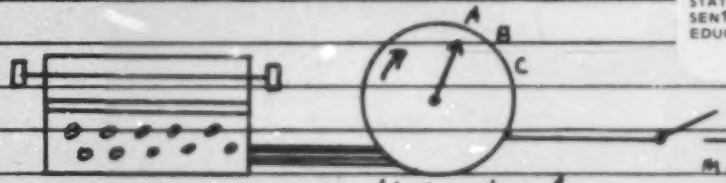
CONSTRUCTION MANUAL FOR CAP
(Communication Aid for Paraplegics and Other Severely Physically Handicapped)

Jack —

Is there some we can build



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A Cooperative Effort of

Telephone Pioneers of America

Hoosier State Chapter Number 16

Indiana Dept. of Public Instruction Division of Special Education

Butler University Indianapolis, Ind.

ED 104190

Paul Ash is an educational consultant with the Indiana Dept. of Public Instruction, Division of Special Education. Paul conceived the CAP system and contacted the Hoosier State Chapter to see if a prototype could be built.

Carolyn Battreall coordinated the Pioneer efforts in the development of the CAP. Carolyn has been a Pioneer since 1971.

Jerry Campbell has been a Pioneer since 1976. Jerry constructed the alphabet display housing unit.

Jeremiah Farrell is with the Mathematics Dept. of Butler University. Jerry did extensive research to assure that linguistic patterns of the English language were represented in the alphabet display.

Jack Hancock is a Senior Engineer with Indiana Bell. Jack designed and built the prototype CAP unit. The construction plans were also prepared by Jack.

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Further information on the CAP can be obtained from:

Hoosier State Chapter
Indiana Bell Telephone Company
240 N. Meridian St., Rm. 1737
Indianapolis, Indiana 46204
Telephone: 317-265-2369

January, 1978

or

Paul Ash, Coordinator
Instructional Materials Center
Box 100, Butler University
Indianapolis, Indiana 46208
Telephone: 317-633-5259

Background and Overview

By: Paul Ash, Educational Consultant
Indiana Dept. of Public Instruction

Several months ago I received a request from a Director of Special Education. He knew of a child who had not attended school because of severe physical impairments. The child was completely paralyzed with the exception of being able to control his eyelids. The director wanted to know if any device existed which would enable this child to communicate. We could locate none.

Life, for this child, consisted of being carried from his bed to another room to watch television and, at the end of the day, being carried back to bed. One day, someone asked him questions about a ball game he was watching. He was to answer by blinking his eyes. To the surprise of everyone, the child knew who was playing, pitching, winning, etc. He did have intelligence. If only a way could be devised to allow communication.

This problem remained in my mind for some time. There must be some way to devise a communication arrangement for an intelligent individual even though the individual has only one controllable muscle movement.

Finally, an idea came to mind. Could a teletypewriter be connected to a rotating display of the alphabet? If it could, then a microswitch could be used to enable an individual to type and thus communicate. The rotating display of the alphabet was the key. It provided the element of time which permitted alphabet selection with only a single muscle movement. Even the blink of an eye could enable a person to type and communicate.

Compared with designing and building a prototype unit, the original idea was relatively simple. What was needed was an engineer with the interest and ability to actually design and build a prototype.

As a former Bell employee, I was familiar with the many

community service projects of the Telephone Pioneers. I contacted the local Pioneer coordinator, Carolyn Battrell, who put me in contact with Jack Hancock. Mr. Hancock took an immediate interest in the project and set out to design a prototype unit.

Shortly after meeting with Mr. Hancock, I was describing the CAP (Communication Aid for Paraplegics) unit to Jeremiah Farrell of Butler University. He, too, took an interest in the project and began designing the alphabet display board. He used his linguistic and cryptographic skills to design a display that would maximize the speed with which words could be typed. This was a significant advance over the original design which contained letters in alphabetical sequence.

Where are we now? The prototype unit is nearly completed and will be field tested in a local rehabilitation center. The construction manual has been produced so that other chapters can begin constructing, refining, modifying and improving upon the prototype. A device does exist which will permit expressive communication with the use of a single controllable muscle movement.

The prototype CAP unit and manual would not exist if it were not for many willing, able and caring members of the Hoosier State Chapter. We hope, and know, that other chapters will also willingly work to change the lives of thousands through CAP construction, refinement and modification.

Construction Procedures for CAP-Model 1

By: Jack Hancock, Senior Engineer
Indiana Bell Telephone Co.

Parts List

QTY	ITEM	DESCRIPTION	NOTE
60	NE2H	Neon Lamps	1 & 4
1		1 RPM Motor	2
1		Switch toggle (SW-1)	
1		Switch non-locking (SW-2)	
1		Box (See sketch A)	3
1		Line Cord	
1		Terminal Strip (6 lug)	
2		Rollers/metal strips for contacts	Fig-2
1		Rod-metal or wood app. 6"	Fig-1
1	200k or 22k	Resistor ± 10%, 1w	4
1	SB 10	Fuse	
1	Misc. wire	16 GA.	
1		Copper sheet to make terminal plates for Fig-1 contacts	Fig-1
1	ASR 28 or 33	Teletype	
1		Mod Kit for Auto LF & CR	

Notes:

1. Quantity determined by lettering configuration. The prototype has 60.
2. Motor RPM determines speed and is a major consideration. Types to be used can be "fixed", "geared" or a motor speed control can be used to vary arm speed.
3. Back of box should be covered with 1) hinges, 2) sliding door, or 3) screws to prevent possible hazardous shock.
4. NE2 lamps can be used in place of the NE2H lamps. The only difference is that the NE2's are dimmer. Use 200k resistor for NE2H lamps. Use 22k resistor for NE2 lamps.

1.01 The aid consists of two units, the teletype and the display box.

2.01 The display box should have the required number of holes drilled in a circular fashion so as to insert and glue the NE2H lamps.

2.02 The box construction should be of either colored plexiglass (or plastic) or of wood. The prototype was constructed as shown in Sketch A.

2.03 Power is applied by means of the line cord. When (SW-1) is activated, the NE2H lamp associated with outside shorting plate (P1) should be on via the 22k ohm resistor, through the lamp to the contact, through the shorting plate to the second contact back to the line cord via (SW-1). These lamps have no control on the actual operation and act only as a visual reference.

2.04 The second set of contacts act as a pulsing point to step the teletype tape reader.

2.05 When the second Shorting plate (P2) crosses each pair of pulsing contacts, continuity is made (a short) to the Teletype (see 3).

2.06 Activation of (SW-2) bypasses step 2.04 so that manual stepping can be accomplished so that the tape (see 3) and the associated lamp (see 2.03) can be synchronized.

2.07 (SW-1), when operated, automatically starts the motor.

3.01 Leads from the terminal strip (TS-1) 1 and 4 go to the teletype (ASR28 type or similar).

4.01 A mylar tape, punched in the exact sequence as stenciled on the box should be spliced as shown in Sketch B. Mylar is used for durability only, as a paper tape would perform the same function.

4.02 As the contacts (P2) are passed, the associated lamp is lighted and a pulse steps the tape to the corresponding position.

4.03 Whenever it is desired to print a particular letter, a short is applied via a switch, contacts, or equivalent means to activate the ASR28. The ASR28 will print whatever position corresponds on the tape reader. Therefore, it is imperative that the Tape and lights are in sync.

4.04 To syncronize the lights and tape, switch 2 should be depressed the required number of times.

5.01 Contact closure is all that is required for the "print function". As each individual situation requires its own unique way to make some movement, leads are provided for easy connection.

6.01 The teletype printer should always be "blinded" until contacts are closed by 5.01. This "unblinds" the teletype and the character corresponding to the light and tape is printed.

FIGURE-1

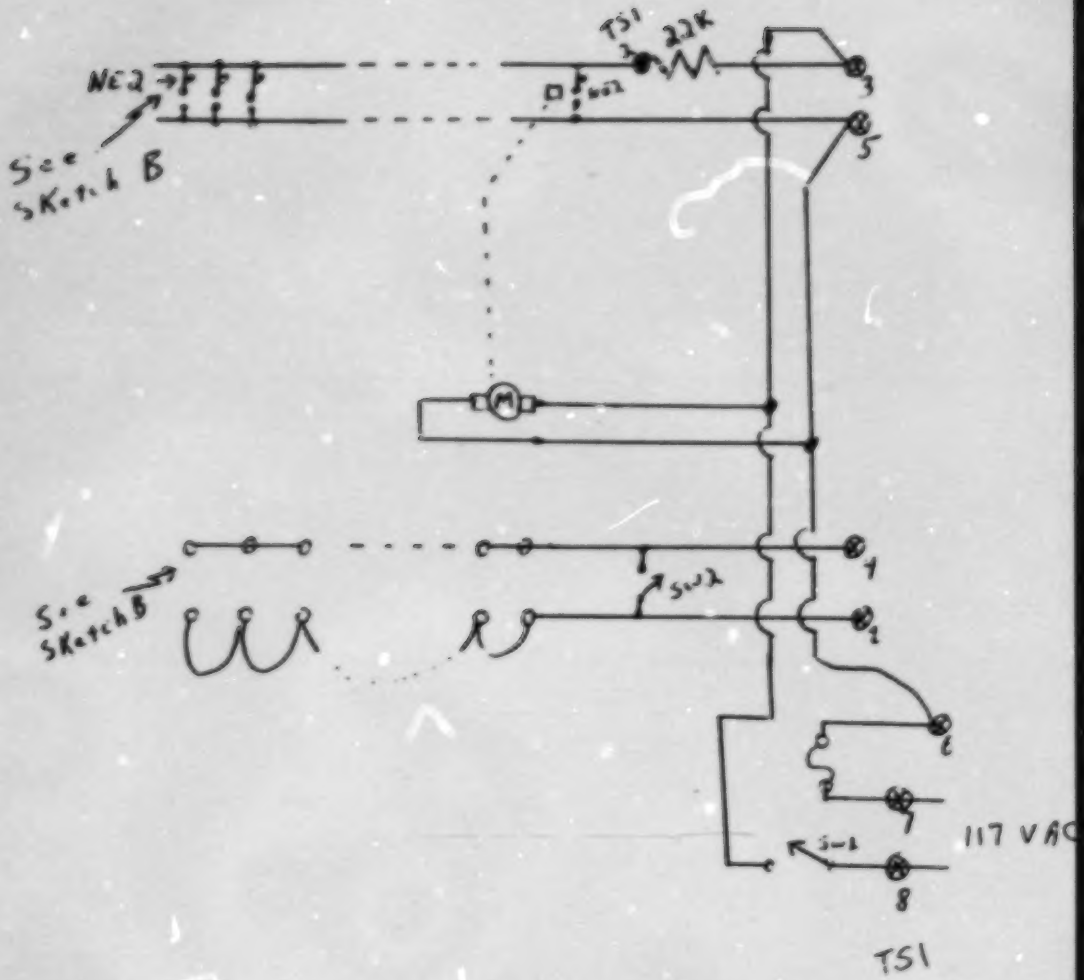
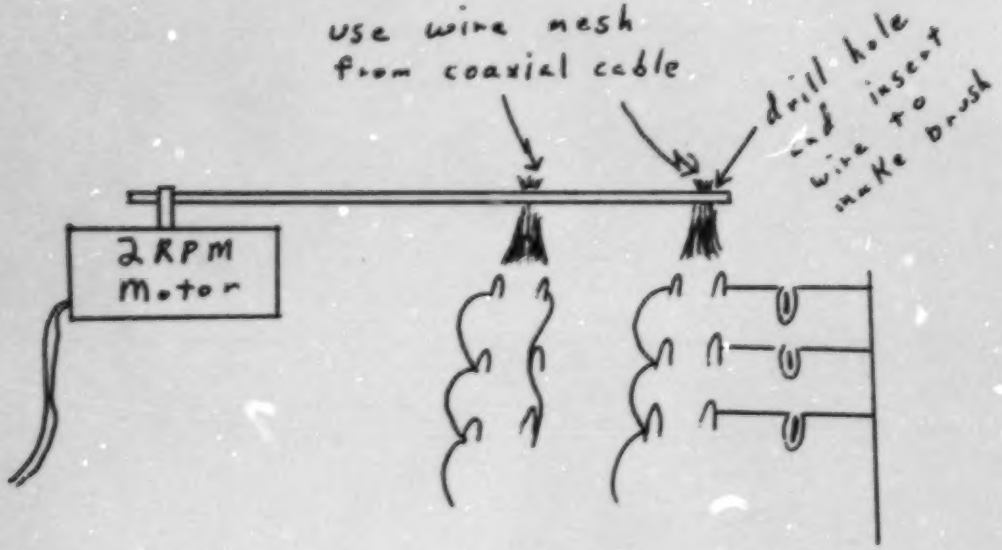
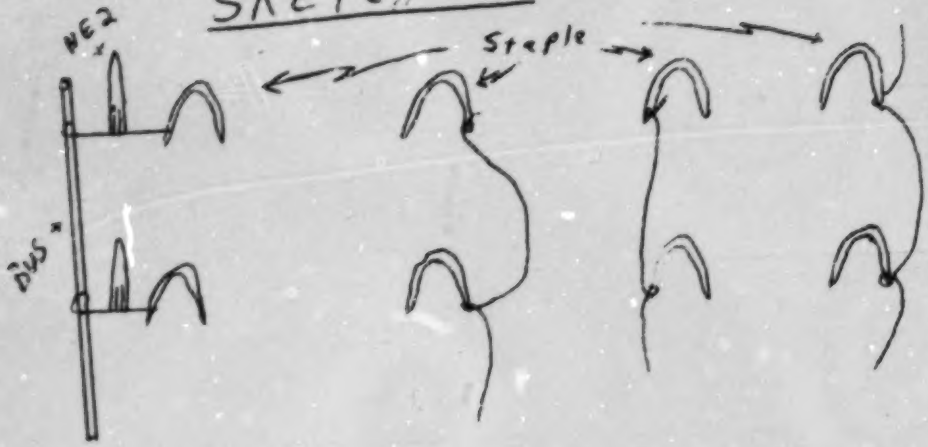


FIGURE-2

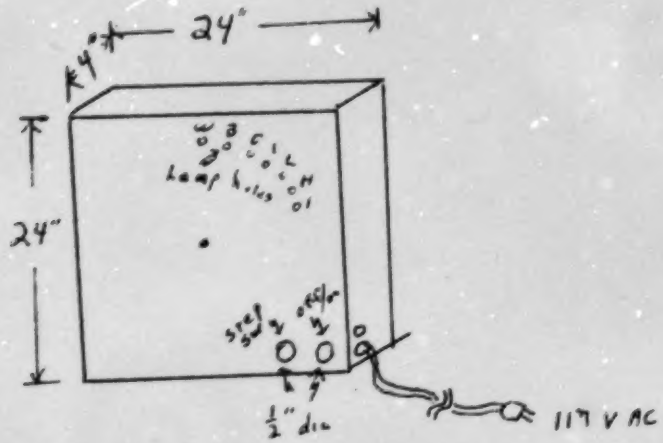


Note: As wire brushes pass over the staple contacts they effectively provide a short. Those with a lamp act as indicators.
Those with only the staple contacts act as stepping contacts.

SKETCH - B

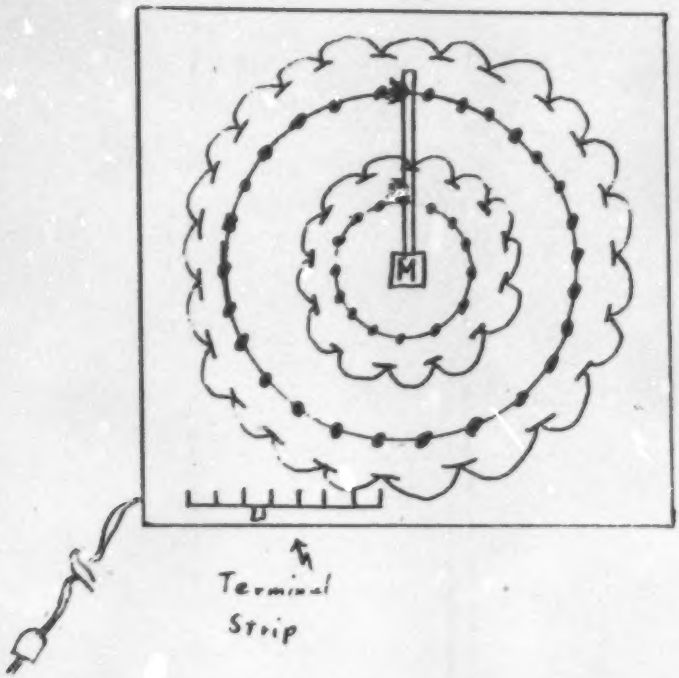


SKETCH - C



Front View

Sketch - D



Back View

Alphabet Display: Factors Influencing Design and Modification

By: Jeremiah Ferrell
Mathematics Dept., Butler Univ.

The sequential display of letters on the wheel was designed to efficiently spell the 1000 most frequent words in the English language. These constitute over 90% of non-specialized English usage.

It would clearly not do to have a simple alphabetical arrangement. A patient wanting the word "on", for example, would have to wait one full sweep of the alphabet to spell it. It is of no help to reverse the letters "n" and "o" either--he may instead want to speel "no". And what if the phrase "no one" was required?

To solve the problem, it was decided a special double wheel was needed. If the patient had two motor movements (ability to blink both eyes, etc.) he would be able at every step of the pointer to activate two separate switches. Two concentric listings of the alphabet are placed on the perimeter of the wheel (see diagram). One switch causes the outer letter to be printed while the other prints the inner letter. Notice in the diagram the occurence of an outer "o" over an inner "n". At this single step of the pointer either "on" or "no" can be printed by the patient reversing the order he flips the switches.

Frequency charts of the single letters, bigraphs (on-no is the fourth most common reversal), and trigraphs were consulted to place the letters on the wheel. In addition, attention was paid to the seven most frequent beginning letters of English words as well as the seven most frequent ending letters. This last remark means that the pointer should always rotate in a clockwise manner.

Since numbers rarely occur in non-technical English it was felt they should be left off the wheel to save space. "One" and two" are the most frequent numbers and they each occur less than 25 times in 10,000 words. It is no loss to spell them.

The average word length in English is approximately 4.5 letters. This fact, along with ending letter frequencies, was used to place blank spaces on the display. The only puncuation symbol used on the wheel is a period. Later versions may add other marks.

It is anticipated that after some practice a patient will develop as much facility with the wheel as a typist has with a keyboard. With this in mind, the speed of the wheel may be adjusted. At no time, however, should the speed be such that two strikes of a switch can not be made per one step of the pointer. Not only does this slow spelling by not allowing reversals, it slows the spelling of words with double letters.

Diagram for Double Wheel

I.
W B O I L H I E N D A V G Z (outside circle)
M Y F A U T C R O T S E . x E (inner circle)

II.
M Y F A U T C R O T S E . K E (outside circle)
W B O I L H I E N D A V N S (inner circle)

III.
W B O I L H I E N D A V J Q (outside circle)
M Y F A U T C R O T S E . E U (inner circle)

IV.
M Y F A U T C R O T S E . P X (outside circle)
W B O I L H I E N D A V L E (inner circle)

Double Alphabet on the Wheel: The four numbered lists follow serially around the circumference of the wheel, each occupying a 90 degree segment.

If a patient does have use of two motor movements, he should be able to average approximately four words per

revolution. The wheel is designed with a full alphabet on the outer wheel so that it can be used by those with a single motor movement also. The printing rate for these patients will be appreciably slower, however.

A more comprehensive analysis of the word wheel will appear in a forthcoming issue of the journal Word Ways. Comments and suggestions for improvements are invited.

Contact: Jeremiah P. Farrell
Butler University
Indianapolis, Indiana 46208

REGISTRATION FORM

CAP (Communication Aid for Paraplegics and Other Severely Physically Handicapped)

It is essential that each CAP unit be registered. This is necessary to 1) monitor developments and improvements; 2) maintain an accurate listing of contact persons; and 3) aid in trouble shooting. Please complete the following information and return completed form to: Hoosier State Chapter, Indiana Bell Telephone Company, 240 N. Meridian Street, Room 1737, Indianapolis, Indiana 46204.

Person(s) who constructed the CAP
Name_____
Address_____
City_____State_____Zip_____
Is this person the primary contact person for further information on this unit? Yes____ No____
If not, who is the primary contact?
Name_____
Address_____
City_____State_____Zip_____

How many hours were needed to construct the CAP unit? _____
Did you incorporate any design alterations, improvements or refinements? Yes___ No___
If yes, please describe these on the back or use attached sheets.
Will the CAP unit be used by one individual or placed in a facility where several clients will use it?
Single individual ____ Facility with several ____
How many and what types of micro switch(es) were produced for clients?
_____

Were any direct costs involved in the construction of the CAP?
Yes___ No___
Please list these costs (do not include volunteer labor or donated or obsolete equipment used). _____
Where will the CAP unit be located? _____
Name of person or facility _____
Address _____
City_____State_____Zip_____
Telephone_____

A picture of the completed unit will be most useful. The picture may be of the CAP unit or of the unit being operated by a client. If the client is photographed, be sure to obtain a release.

RELEASE

I give my permission to have my picture taken and used to publicize the CAP system so that others may be informed of its uses. I understand that my photograph may be reproduced and distributed.

Signature (Client or Guardian)_____
Witness_____
Date_____